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Machine Applications

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A Guideline in Business Education for
the Intermediate and Senior Divisions
1976

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General Information

– This guideline replaces *Business Machines and Mathematics, Grade 10,* and *Business Machines, Grades 11 and 12,* in Curriculum RP. 31.

– Courses based on this guideline, *Machine Applications,* may be offered for partial credit, a full credit, or more than one credit.

– Where the course is introduced in the Intermediate Division, it is recommended that it be begun in the fourth year of that division.

– Courses based on this guideline provide alternatives for students who are interested in business mathematics but who do not wish to take courses based on *Mathematics, Senior Division, 1972, Applications of Mathematics 1 and 2.*

Rationale

In recent years there has been a growing recognition that students would benefit if courses in business problem-solving and business machines were combined. *Machine Applications* combines these two subject areas into one course and at the same time responds to three developments.

First, electronic calculators are now replacing other types. Inexpensive hand calculators are in common daily use. Business firms are moving towards using the ten-key machine almost exclusively. Business machine courses that formerly used a variety of machines are now standardizing on one type. The classroom time needed to acquire a working familiarity, and even proficiency, with a ten-key calculator is relatively short.

Secondly, changes in school schedules have necessitated a review of existing courses. Before the introduction of the credit system, secondary schools allotted two or three periods a week to courses in business machines. With the general standardization of course lengths – one period a day is allotted to each subject or course – more time became available. Such extended instruction in business machines over a full year or even a semester, however, seemed excessive. The available time thus permitted combination with a business problem-solving course.

Thirdly, it was recognized that students needed much more practice in solving mathematical problems – both of a personal nature and those with a business orientation. Practice in problem-solving would give students the opportunity to practise the skills of calculation and logical thinking. A course that focuses on problems that one is likely to meet in daily life has immediate relevance for all students; it can have special and continued significance for students embarking on careers in the world of business.

The modern technology of business machines provides a simple means of performing the necessary calculations involved in business procedures and general problem-solving. It is, therefore, appropriate that these aspects should be combined in this one guideline, *Machine Applications.*

Aims

From this guideline, teachers of Machine Applications will be able to plan courses that are consistent with the following aims:

– to enhance the student's ability to use data in applied mathematical problems;

– to develop problem-solving abilities;

– to further the student's ability to organize, classify, present, and interpret data, and to develop skills in statistics;

– to familiarize students with the operation of one type of calculator and to develop the necessary skills, emphasizing the ten-key touch so that the machine becomes an effective aid in performing arithmetical operations;

– to acquaint the student with the value of calculators and their usefulness in various disciplines;

– to provide the opportunity for the review of basic arithmetical and algebraic concepts and skills and to relate them to applied personal and business problems;

– to encourage students to develop an understanding of and interest in the business affairs of the local community.

Designing the Program

The basic operation of the calculator should be learned before performing applications so that the machine itself should not become an obstacle in the process of seeking a solution to a problem.

Essentially there are three approaches to teaching the use of the calculator. Some teachers may wish to teach its use at the beginning of the year, others at various times during the year, and others as the need arises.

Facility with the calculator is likely to be achieved more quickly when the basic operations are taught at the beginning of the course for a full period each day, using the ten-key touch until the student reaches a degree of proficiency where the machine becomes an effective aid in performing arithmetical operations. After initial skills have been mastered, probably over a period of a month or two, one period a week could be devoted to maintaining skills and to extending them in new machine operations.

A second approach is to teach the various calculator skills at various times during the year according to a plan.

A third approach is to develop the new skill or function as the need for it arises in the process of seeking a solution to a problem. In this approach, necessity becomes the key ingredient.

Naturally, the length of time needed to develop machine skill is dependent on the number of calculators in the use of which the student is to be trained. At the beginning, the student should develop competence on one type of calculator, and later in the course he or she may be given an opportunity to use another type of machine if he or she wants to do so.

This guideline is the basis for courses that blend calculator skills with experience in problem-solving. The approach to problem-solving can be either topical or thematic.

The topical approach might be chosen by a teacher handling the subject for the first time. In the following sections many topics are suggested. It is expected that appropriate, relevant examples will be selected for any topics chosen.

The thematic approach, while it involves the teacher in the preparation of large amounts of material, provides a correspondingly rich learning experience for the students.

However, it is also possible to use variations or combinations of these two basic approaches. A teacher might start with a topical approach, then, as material is accumulated and developed, he/she might use a mini-theme approach and, finally, conclude with a master-theme approach as a summary. As additional material is gathered and more experience is gained, the master theme approach might be used for the whole year. This could be based on the examples suggested in the business problems approach, but it would be preferable to base it on community resources and the particular interests and needs of the students.

Business problem themes might be more suitable for the first year of the course, and personal mathematics problem themes for the second year.

It should be noted that courses developed from this guideline can be adapted for classes where some of the machines used are not electronic calculators.

Business and Personal Mathematics Problems: Topic Approach

This is an approach in which courses are based on the topics of business mathematics. Topics encountered in most mathematical problems are taught first: estimation, computation, fractions, aliquot parts, percentage, ratio, and proportion. Topics in business mathematics usually begin with simple interest, commission, discount, and other applications of percentage, progressing towards compound interest, stocks and bonds, and foreign exchange. These topics can cover both business and personal problems.

The list of topics given below is neither all-inclusive nor prescriptive. Teachers may use it as a base in developing a course. As some students will already have explored certain topics in other courses, courses will need to be designed for individual class programs.

Aliquot Parts
Annuities
Banking
Borrowing
Budgeting
Checking and Verifying
Commissions
Computation
Credit Buying
Decimals
Discounts
Duties
Estimation
Financial Statements and Analysis
Foreign Exchange
Fractions
Graphs
Instalment Buying
Insurance
Interest
Inventory
Invoicing
Markup and Markdown
Measurement
Mensuration
Merchandising Applications
Payroll
Percentages
Present Value
Pricing
Probability
Proration
Ratio and Proportion
Statistics
Stocks and Bonds
Storage
Taxation

Many other topics may be added, particularly topics that invite the application of calculators in other subject areas.

Further, many topics will be affected by the adoption in Canada of the modernized metric system (SI). Metric units will thus become an integral part of the course.

Business Problems: Theme Approach

The theme approach offers great flexibility and at the same time allows in-depth exploration of a topic. For example, a series of themes could be developed on the business mathematics problems that a worker would meet in the various business departments of a firm (payroll, purchasing, sales, manufacturing, and accounting). Another series of themes could be developed around various types of business such as retailing, wholesaling, trading, service, and finance.

The following outline provides an example of a major theme approach.

Theme: Retailing mathematics for a merchandising business such as a music store, variety store, or hardware store in full operation. Operations might include:

1. Store renovations: painting, carpeting, making a floor plan of store area, and other activities that involve measurement and mensuration

2. Purchasing of stock: inventory control, checking and verifying purchase invoices, discounts, federal sales tax, credit terms, interest, storage, buying commissions, duties and excise taxes, foreign exchange, borrowing

3. Selling of goods: pricing, markup and margin, cash and credit sales, provincial sales tax, cash discounts, markdown, financing credit sales

4. Sales analysis: product, sales staff, location and time

5. Financial analysis: pricing inventory; determining operating expenses such as payroll, taxation, insurance, and depreciation; prorating of expenses to departments; statistics with averages; market research with graphs; financial statements with graphs

6. Paying employees: time, piecework, commission, deductions, incentives

7. Investing profits: stocks, bonds, banking, store expansion, product expansion

Personal Mathematics Problems: Theme Approach

Personal mathematics problems could also be approached through a theme. For example, a series of themes could be developed around such personal mathematics problems as checking the payroll slip, making an income tax return, buying goods or services on credit or on instalment, buying a home, and investing money.

A series of themes could be developed around the special interests of teenagers. These could include the financing of a major purchase, the funding of school trips, and the calculation of sports statistics.

The following provides an illustration of a course organized around a personal mathematics theme.

***Theme:* Earning, Spending, Saving, and Investing**

Earning
Calculation of earnings: methods of payment, deductions, graphs to illustrate distribution of earnings between various deductions and net pay

Spending
1. Cash: discounts
2. Credit: interest and carrying charges, effective rate of interest
3. Borrowing: interest and monthly payments on whole and diminishing balances, finding rate when principal and amount are known
4. Travelling: foreign exchange

Saving
1. Budgeting of income: percentage, graphs
2. Calculation of interest paid by banks, trust companies, credit unions

Investing
1. Stocks: graphing price changes, buying and selling, yield, price-earnings ratio
2. Bonds: yield, buying and selling between interest dates
3. Tax credits: influence of tax credits in calculating net return on stocks and bonds
4. Statistics: consumer surveys, financial reports, averages, graphs
5. Home ownership: buying a home *vs.* renting, municipal taxation, mortgage payments, amortization, property insurance, adjustments to purchase price, cost of ownership in terms of monthly rental values, household operating expenses, loss or gain on investment

Suggestions for Teaching Machine Applications

1. Machines in the Classroom
Today's classrooms are likely to have a large number of machines because of their ready availability. The ten-key electronic calculator is becoming the dominant machine because of its low price, its versatility, its speed, and its low maintenance cost.

In the early stages of the course when machine operation is being learned, each student should have a ten-key calculator by his/her desk. In this way, the machines can be constantly at hand and their use integrated with course topics. In the later problem-solving stage, the machines could be arranged around the perimeter of the working area or in clusters. Such an arrangement will encourage the student to regard calculators as special devices to be used when needed. In any case, the location of machines will, to some extent, depend on the needs of the course and the types of equipment available in the community.

2. Algebra as a Tool
The purpose of teaching students algebra in this course is to provide them with a tool they can use in solving business arithmetic problems. The study of basic examples of expressions, substitutions, addition and multiplication, the concept of exponents, the manipulation of formulae, and the construction of an equation are facets of algebra that may be covered. Depending upon the ability of the students and their previous experience in this branch of mathematics, the necessary algebra can probably be covered in a month or two.

3. Problem-solving Techniques
It is essential that students be given opportunities to develop problem-solving techniques and to relate skills to practical problems. It is also essential that teachers assist students to read with comprehension. When they understand the problem at hand, the ideas must still be translated into a mathematical statement. The use of ratio-and-proportion as one approach should assist the student to express his/her ideas in the statement.

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4. The Place of Rapid Calculation
With business machines so readily available, rapid calculation may be viewed in a different light. Work such as the following can be done more efficiently by machine: the addition of long columns of figures, the multiplication of large numbers, the division of a quantity to many decimal places.

Mental and written calculation, however, will still be required in estimation, the placing of decimals, the determination of unit price, and various other situations. At the same time, estimation has assumed a new importance because unquestioned reliance on electronic calculators could lead to errors and necessitates the use of estimates as a safety check. However, much of the time formerly devoted to rapid calculation can be used to develop skills of reasoning and expression.

5. Integration of Machine Applications
Students should have every opportunity to relate their work in Machine Applications to the business life of their community and to other courses within their school.

They should work with source documents used in local businesses, such as invoices, storage forms, and taxation forms. They should study current business statistics and graphs, analysing and interpreting them.

It is important that teachers in a school take a team approach to the integration of subject matter in various courses. They should make every effort to exchange course outlines, information, and ideas, and should endeavour to plan together the presentation of subject matter in related courses. For instance, if one teacher teaches a set of principles in one subject, the other should develop work based on the principles already taught.

The business machines area in the school should be made available, whenever possible, for work in a wide range of courses and situations. The calculators can be used effectively in accounting classes, in merchandising and marketing classes, in the computer science field, in the commercial practice office, and in courses in geography, mathematics, and science.

Evaluation of Student Achievement

The general aims of courses developed from this guideline have already been listed. In line with these aims, it is the responsibility of teachers to develop a program that students will both enjoy and find useful. Hence it is essential that a teacher become aware of the needs, interests, and abilities of the students and take a close look at their individual characteristics.

Just as a teacher has teaching aims, so students have their hopes and aspirations. Teachers and students should, therefore, set down their objectives together. Parents, and many other members of the community, also have their expectations. It is in this context of aims, aspirations, expectations, and objectives that evaluation of student achievement takes place.

The measurement of achievement and the making of professional judgements are a part of every business machine course. Teachers should continue to rely on careful observation of daily student work as the main base for evaluation. Along with this continuing evaluation of individual student progress, short tests should be given periodically or at the completion of a unit of work. Criterion-referenced testing has a special applicability in Machine Applications. Individual and group research projects and related case studies provide information about another aspect of student achievement. In summary, a final evaluation should have as broad a base as possible, so that as many dimensions of a student's achievement may be recognized as possible.

Balanced judgement must be exercised in evaluating work that has been well reasoned out but is inaccurate in its results. The achievement of correct results is important, and deserves credit; logical thought, however, is also important, and also deserves appropriate credit.

Evaluation can become a valuable learning experience if students are given opportunities for self-evaluation. Students can share in the setting of goals in the light of which their performance is subsequently examined. Students can compare their actual achievement with their expected achievement. Through discussions between student and teacher, it is possible to confirm, moderate, or amplify the initial self-evaluation that a student makes.

More important to teacher and student than the letter grade or percentage mark is an awareness of what is being done effectively and what is in need of improvement.

Resource Materials

Note:
1. Titles of textbooks approved for use in Machine Applications courses will be found in *Circular 14: Textbooks*.

2. The following entries provide information on books, brochures, and other materials that might be of assistance to teachers as they develop courses in Machine Applications. In general, the items represent *materials for teacher use, not for student reference*.

3. The resource materials are divided into three categories: calculator operations, practice sets and exercises, and problem-solving.

Calculator Operations

Briggs, Robert, and Kosy, Eugene. *Office Machines: A Collegiate Course*. 2nd ed. Cincinnati: South-Western Publishing, 1973. (Gage Educational Publishing, Agincourt, Ontario.)
This textbook-workbook gives instructions and exercises for many types of adding machines and calculators. The book is suitable for use at the Senior Division level.

🍁 Olivetti. *Divisumma 24: 30 Lesson Practice Course*. Toronto: Olivetti Canada, 1966.
This student booklet describes machine operations for many practical business applications. Student answer sheets and a teacher's manual are also available.

🍁 Olivetti. *Underwood 581: Office Practice Course*. Toronto: Olivetti Canada, 1975.
This student booklet is designed to facilitate the use of one type of calculator. Each of the 20 lessons in the course covers a different aspect of common business applications.

Pasewark, William R. *Electronic and Mechanical Printing Calculator Course*. Cincinnati: South-Western Publishing, 1974. (Gage Education Publishing, Agincourt, Ontario.)
Instructions in this book cover a variety of machines to give students competency in using the ten-key touch system. Six achievement tests, plus a pre-test and post-test, are provided in a separate leaflet.

Practice Sets and Exercises

Albertson, Dorothy. *Business Machines Practice Set*. New York: McGraw-Hill, 1974. (McGraw-Hill Ryerson, Scarborough, Ontario.)
This set consists of 56 jobs. (Instructions and forms are provided for each job.) Students are asked to handle all basic procedures involved within the

following departments: Inventory Control, Purchasing, Sales, Accounting, and Payroll. Place names and tax figures are American. A teacher's manual is also available.

Cornelia, Nicholas J., and Agnew, Peter L. *Machine Office Practice.* 2nd ed. Cincinnati: South-Western Publishing, 1971. (Gage Educational Publishing, Agincourt, Ontario.)

This integrated practice set includes a booklet of job instructions and several packages of business forms and papers. The set simulates actual office situations, using realistic business forms. A teacher's manual is available.

🍁 Dool, J. H. *Business Machine Exercises.* Toronto: McGraw-Hill Ryerson, 1963.

The material in this workbook covers the basic operations of the various machines found in the average classroom or business office. One section is allocated to each of the four fundamental operations and a fifth section treats multiple operations.

🍁 English, Ross S., and Pactor, Paul. *Business Machines Projects.* Rev. ed. Toronto: Pitman, 1973.

The approach is thematic, dealing with the operations of one company. This book of projects contains three sets of parallel exercises which could be used as a teaching cycle, a skill development cycle, and a testing cycle.

Huffman, Harry. *Programmed Business Mathematics.* Book 1. 3rd ed. New York: McGraw-Hill 1975.(McGraw-Hill Ryerson, Scarborough, Ontario.)

Huffman, Harry, and Schmidt, B. June. *Programmed Business Mathematics.* Book 2. 2nd ed. New York: McGraw-Hill, 1968. (McGraw-Hill Ryerson, Scarborough, Ontario.)

Huffman, Harry, and Schmidt, B. June. *Programmed Business Mathematics.* Book 3. 2nd ed. New York: McGraw-Hill, 1968. (Available from McGraw-Hill Ryerson, Scarborough, Ontario.)

This is a series of three programmed-learning text-workbooks which cover most of the business mathematics topics. These books are particularly suitable for an individualized approach and for remedial work.

Litton Business Systems. *Today's Basic Business Mathematics Through Electronics.* Orange, N. J.: Monroe, The Calculator Company, 1972.

This workbook offers the student a basic understanding of business mathematics and its application to many business situations. At the same time, the student could learn to operate two specific calculators.

🍁 MacLaughlin, K. R., and MacLaughlin, M. E. *Machine Applications for Business Problems Workbook.* Toronto: Pitman, 1973.

This workbook and its accompanying key are designed for use with any type of calculating machine. The calculator is presented as a tool for handling the arithmetic aspect of business operations.

🍁 Pew, G. F., and Jennings, W. H. *Arithmetic for Canadian Business.* Toronto: Pitman, 1958.

Some of the units in this workbook have the types of questions that could be used for drill purposes.

Rosenberg, R. Robert. *Business Mathematics: Exercises, Problems, and Tests.* 2nd Canadian ed. Toronto: McGraw-Hill Ryerson, 1968.

This text-workbook contains materials that could be used in Machine Applications but most exercises can be solved without the use of a calculator. Few problems require written solutions.

Problem-Solving

🍁 Council of Ministers of Education, Canada. *Metric Style Guide.* Toronto: Council of Ministers of Education, Canada, 1975.

This guide provides information on the terminology and symbols to be used as Canada adopts the modernized metric system known as SI.

🍁 Dool, J. H. *Business Machine Problems.* Toronto: McGraw-Hill Ryerson, 1965.

Set up in workbook form, the text first reviews basic operations. The usual business mathematics topics are covered using business applications. The final section reviews most of the business topics of the earlier sections through a case study.

Huffman, Harry; Twiss, Ruth M.; and Whale, Leslie J. *Mathematics for Business Careers.* 4th ed. New York: McGraw-Hill, 1975. (McGraw-Hill Ryerson, Scarborough, Ontario.)

This book presents the basic mathematics skills needed for many office and store situations. Many specific examples are given, making this a handy reference.

🍁 Jennings, W. H., and St. Louis, Mary A. *B Math.* Toronto: Pitman, 1972.

This book contains many sample problems that might be useful to teachers.

🍁 Jennings, W. H., and St. Louis, M. A. *Mathematics for Business and Commerce.* Book 1. Toronto: Pitman, 1965.

This book is well organized and contains many exercises, allowing teachers some freedom of choice. The text includes units on fundamental operations, elementary algebra, mensuration, and business arithmetic.

🍁 Jennings, W. H., and St. Louis, M. A. *Mathematics for Business and Commerce.* Book 2. Toronto: Pitman, 1966.

This book offers many opportunities for business problem-solving using basic arithmetic and algebra.

Mach, M. A., and Larson, Allan. *Math for Today and Tomorrow.* Portland, Maine: J. Weston-Walch, 1968.

Written from the consumer's point of view, the book presents an interesting and different approach to business mathematics. In a case study, Steve and Debby are followed as secondary school seniors and as a married couple who set up a home.

Piper, Edwin B.; Gruber, Joseph; and Milne, Lucy I. M. *Applied Business Mathematics.* Canadian edition. Toronto: Gage, 1967.

The beginning units develop the fundamental principles and operations through a study of personal business problems. These principles and processes are then applied to problems arising in various types of business enterprises. The book reflects Canadian business practices.

Rosenberg, R. Robert; Lewis, Harry; and Poe, Roy W. *Business Mathematics.* 8th ed. New York: McGraw-Hill, 1975. (McGraw-Hill Ryerson, Scarborough, Ontario.)

This book covers the arithmetic skills needed for most business computations, the common problems requiring computations in business, and the everyday topics dealing with personal investment and other consumer items.

Rosenberg, R. Robert, and Poe, Roy W. *College Business Mathematics.* 5th ed. New York: McGraw-Hill, 1973. (McGraw-Hill Ryerson, Scarborough, Ontario.)

This college book contains problems that would not be too challenging for use in the Senior Division. It is designed to meet the needs of those who are preparing for business careers and those who want to review basic mathematics and sample business applications that affect both worker and consumer.

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